Muscles & Bones in Action

- Detailed teaching notes are available in a separate folder.
- You may alter the PowerPoint notes as you wish. For this reason the presented ‘design’ has been kept as simple as possible.
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- None of the material is for use off-site.

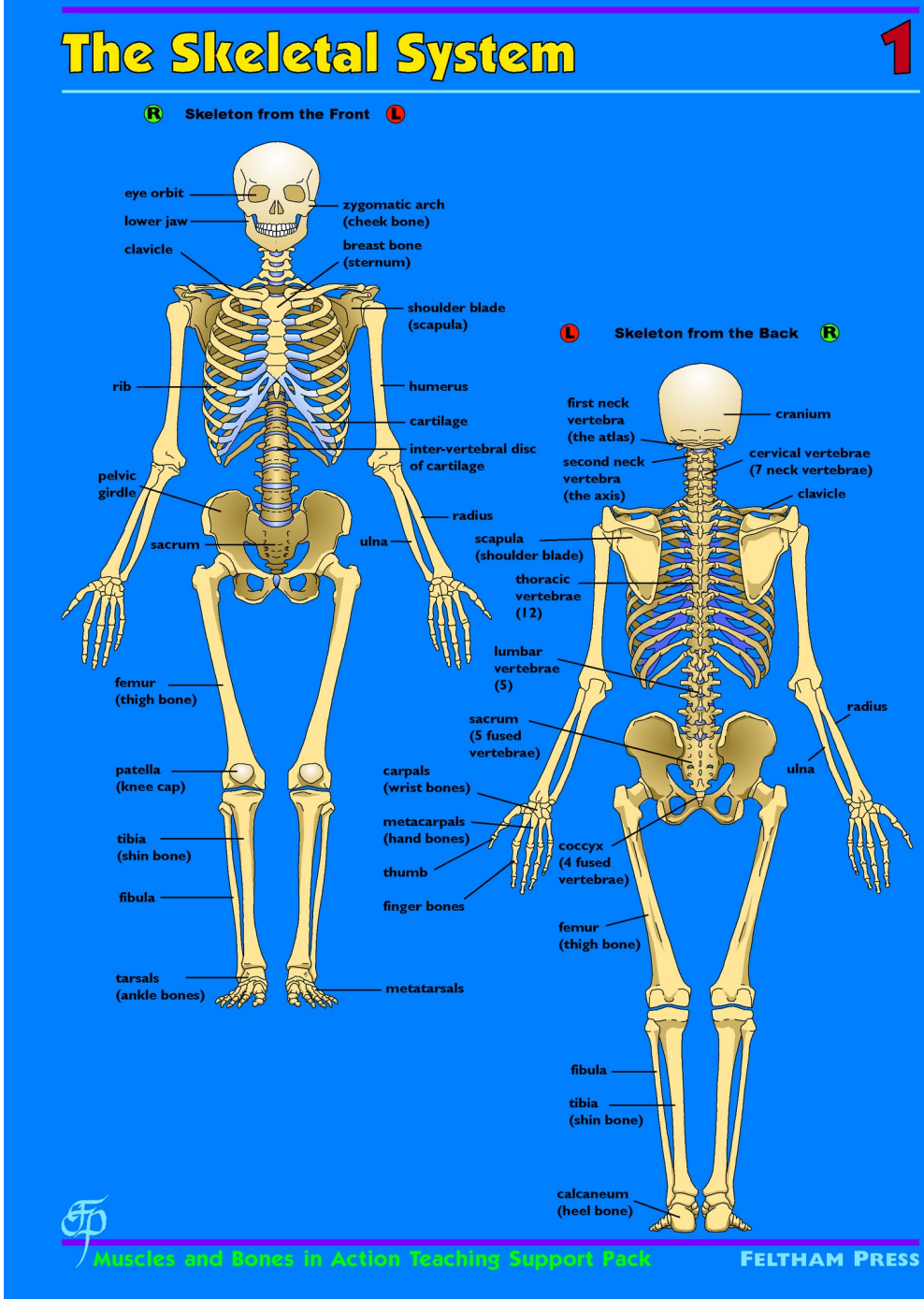
Integrated Systems

- Muscles and bones are fully integrated, both structurally and functionally
- They are dealt with separately for purposes of study but their interdependence should always be kept in mind
- The skeleton presented in the next slide allows identification of its component bones and their relation to each other.

With its long levers it could be said that in general the human skeleton is built for speed and dexterity rather than strength.

The long levers of the arms and the legs work at a mechanical disadvantage, but allow wide arcs of movement at the ends of the limbs.

The bones are held together by ligaments and the muscles and



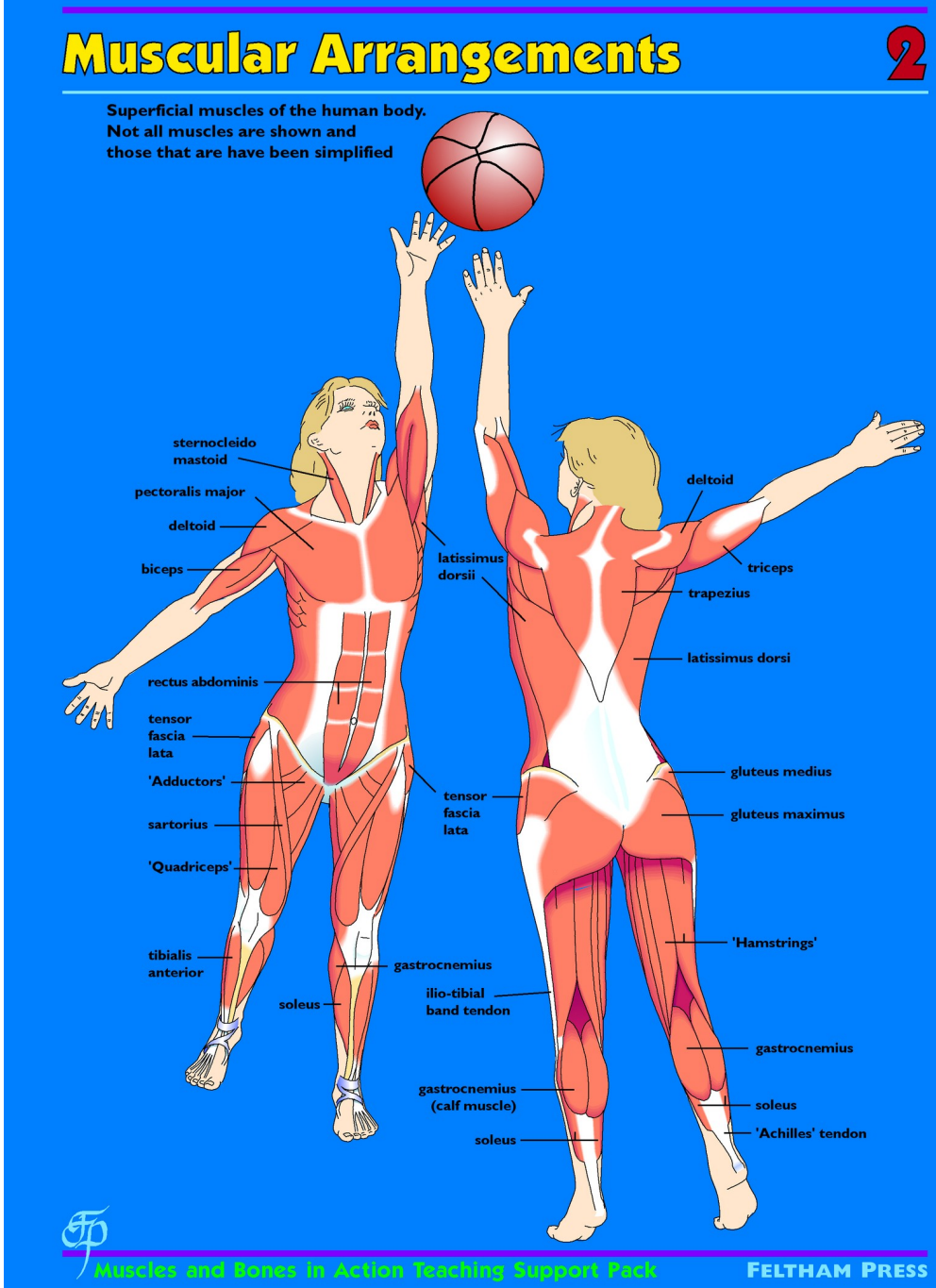
Only some of the major muscle groupings are shown here.

Superficial muscles hide deeper lying muscles.

Muscles are joined to bones by non-elastic tendons.

The shape of the bones reflect their muscle attachments.

Tendon tissue also occurs in sheets with



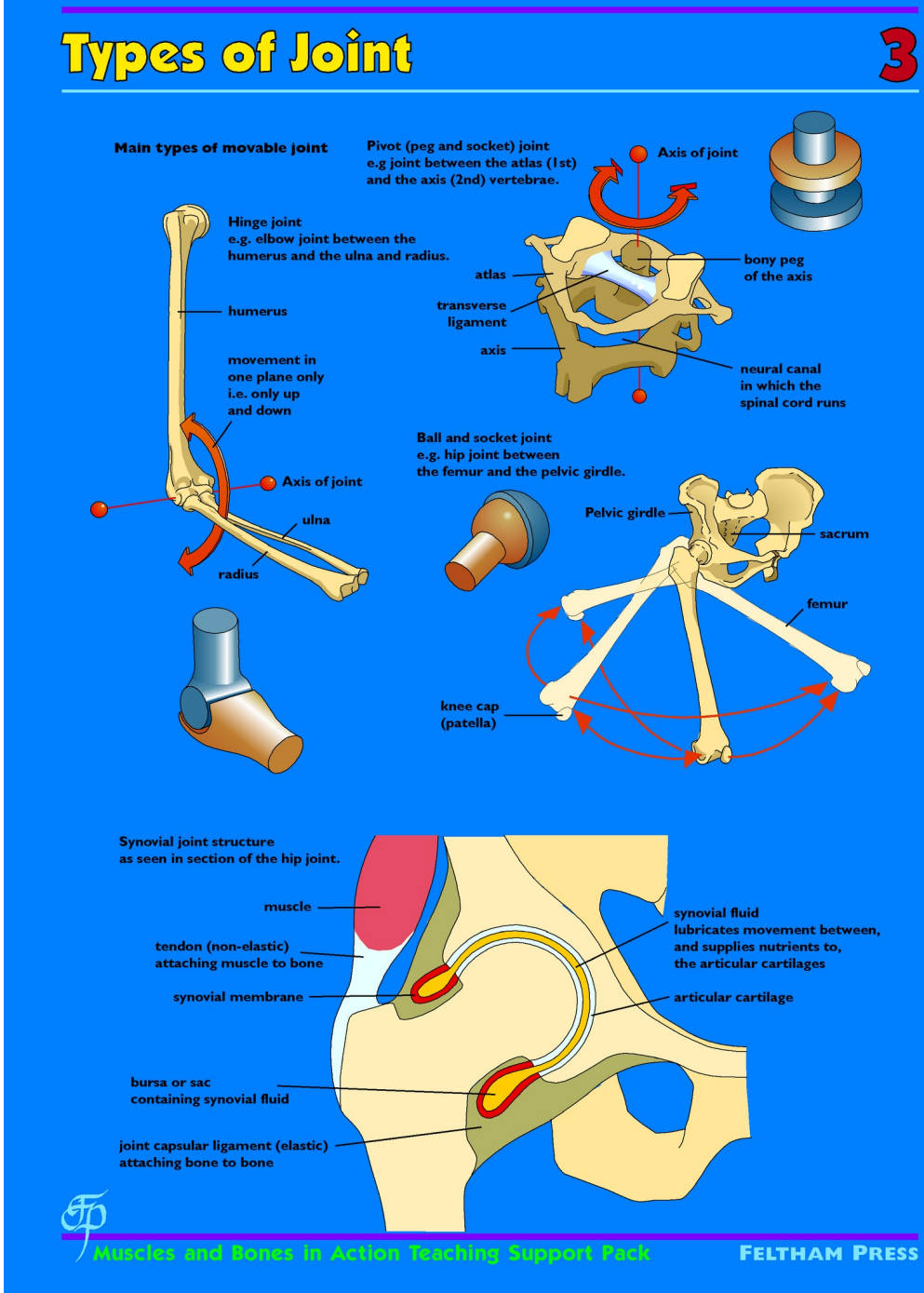
Joints occur between bones.

Some are fused for strength.

Most allow movement between bones that make up the joint.

The main types of joint are illustrated here.

Various combinations of movements of different joints allow for complex


Types of Joint
3
Main types of movable joint
Hinge joint
e.g. elbow joint between the humerus and the ulna and radius.
humerus
movement in one plane only i.e. only up and down
Axis of joint
ulna
radius
Pivot (peg and socket) joint
e.g joint between the atlas (1st) and the axis (2nd) vertebrae.
Axis of joint
bony peg of the axis
atlas
transverse ligament
axis
neural canal in which the spinal cord runs
Ball and socket joint
e.g. hip joint between the femur and the pelvic girdle.
Pelvic girdle
sacrum
femur
knee cap (patella)
Synovial joint structure as seen in section of the hip joint.
muscle
tendon (non-elastic) attaching muscle to bone
synovial membrane
synovial fluid lubricates movement between, and supplies nutrients to, the articular cartilages
articular cartilage
bursa or sac containing synovial fluid
joint capsular ligament (elastic) attaching bone to bone
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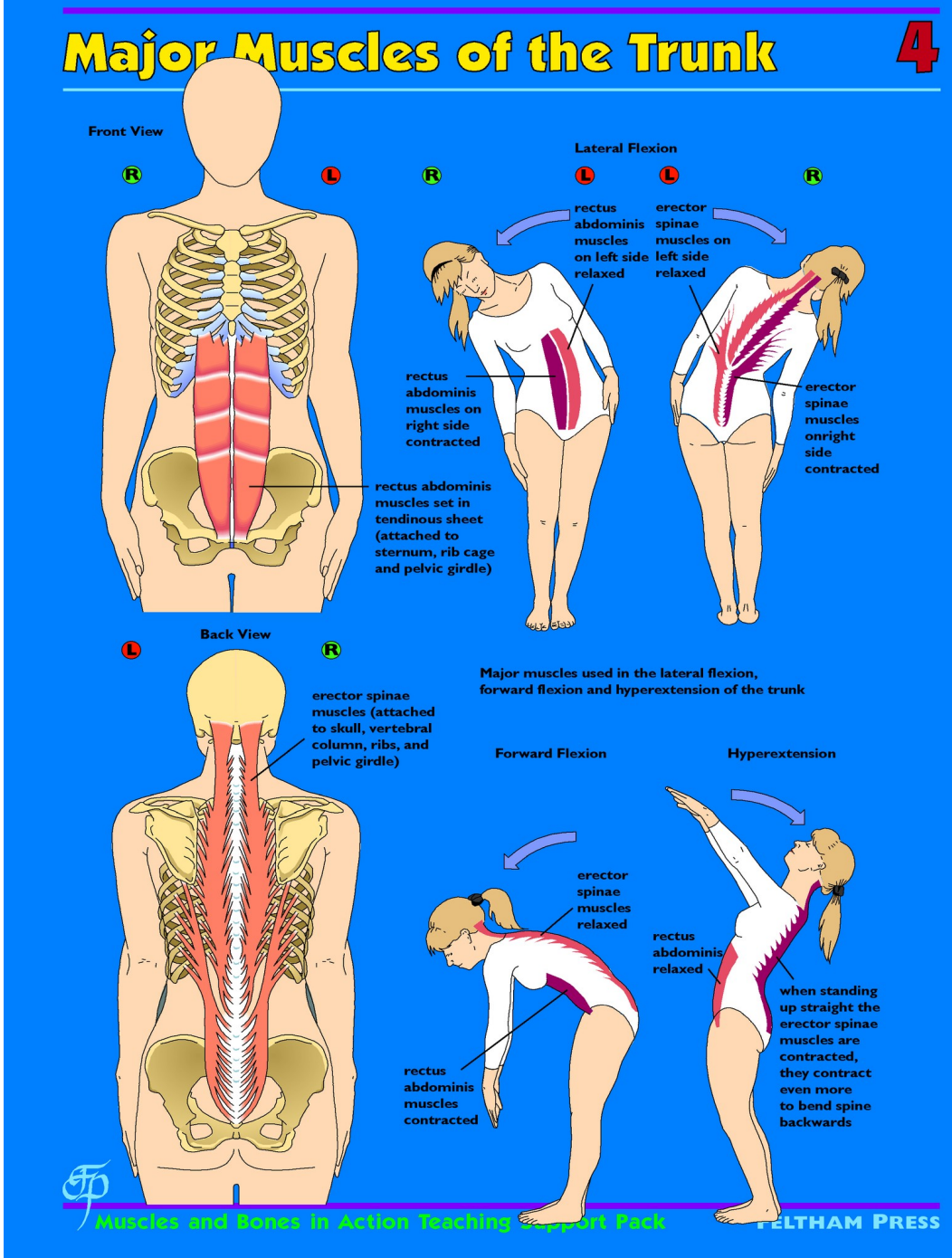
Major muscles of the trunk produce movements rather limited in range and complexity.

They are crucially involved in maintaining the upright posture of the human body.

The back muscles and the abdominal muscles balance each other, and there is some truth in the saying that “the


Major Muscles of the Trunk
4
Front View
R
L
rectus abdominis muscles set in tendinous sheet (attached to sternum, rib cage and pelvic girdle)
Lateral Flexion
rectus abdominis muscles on left side relaxed
erector spinae muscles on left side relaxed
rectus abdominis muscles on right side contracted
erector spinae muscles onright side contracted
Back View
erector spinae muscles (attached to skull, vertebral column, ribs, and pelvic girdle)
Major muscles used in the lateral flexion, forward flexion and hyperextension of the trunk
Forward Flexion
Hyperextension
erector spinae muscles relaxed
rectus abdominis relaxed
rectus abdominis muscles contracted
when standing up straight the erector spinae muscles are contracted, they contract even more to bend spine backwards
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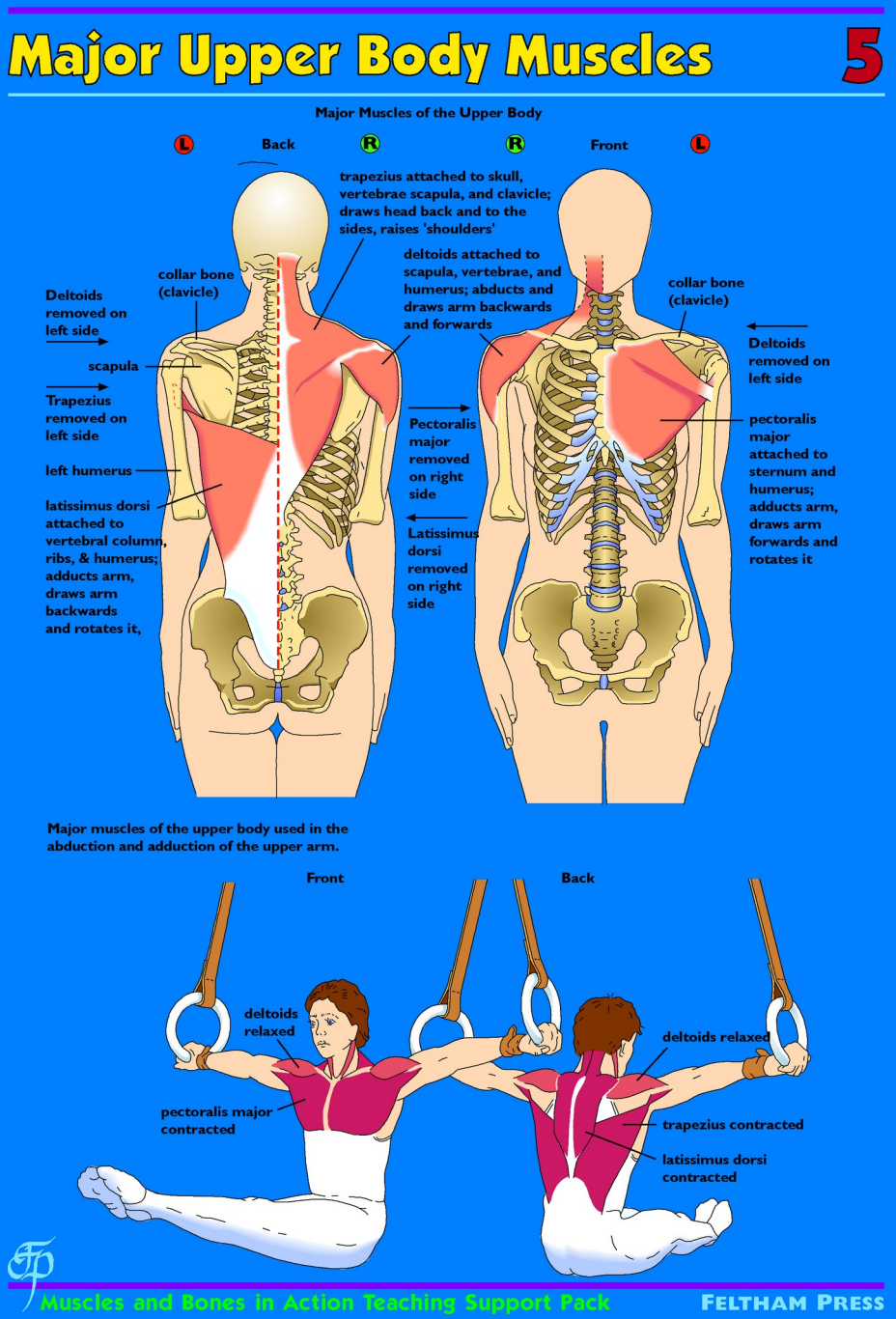
These are involved in the support of the skull and the movement of the arms in relation to the body.

They are important in supporting the ‘loose’ shoulder joint which has a large range of movement.

They also contribute to the protection of the vital organs of the chest.


Major Upper Body Muscles
5
Major Muscles of the Upper Body
L
Back
R
R
Front
L
trapezius attached to skull, vertebrae scapula, and clavicle; draws head back and to the sides, raises 'shoulders'
deltoids attached to scapula, vertebrae, and humerus; abducts and draws arm backwards and forwards
collar bone (clavicle)
Deltoids removed on left side
scapula
Trapezius removed on left side
left humerus
latissimus dorsi attached to vertebral column, ribs, & humerus; adducts arm, draws arm backwards and rotates it,
Pectoralis major removed on right side
Latissimus dorsi removed on right side
collar bone (clavicle)
Deltoids removed on left side
pectoralis major attached to sternum and humerus; adducts arm, draws arm forwards and rotates it
Major muscles of the upper body used in the abduction and adduction of the upper arm.
Front
Back
deltoids relaxed
pectoralis major contracted
deltoids relaxed
trapezius contracted
latissimus dorsi contracted
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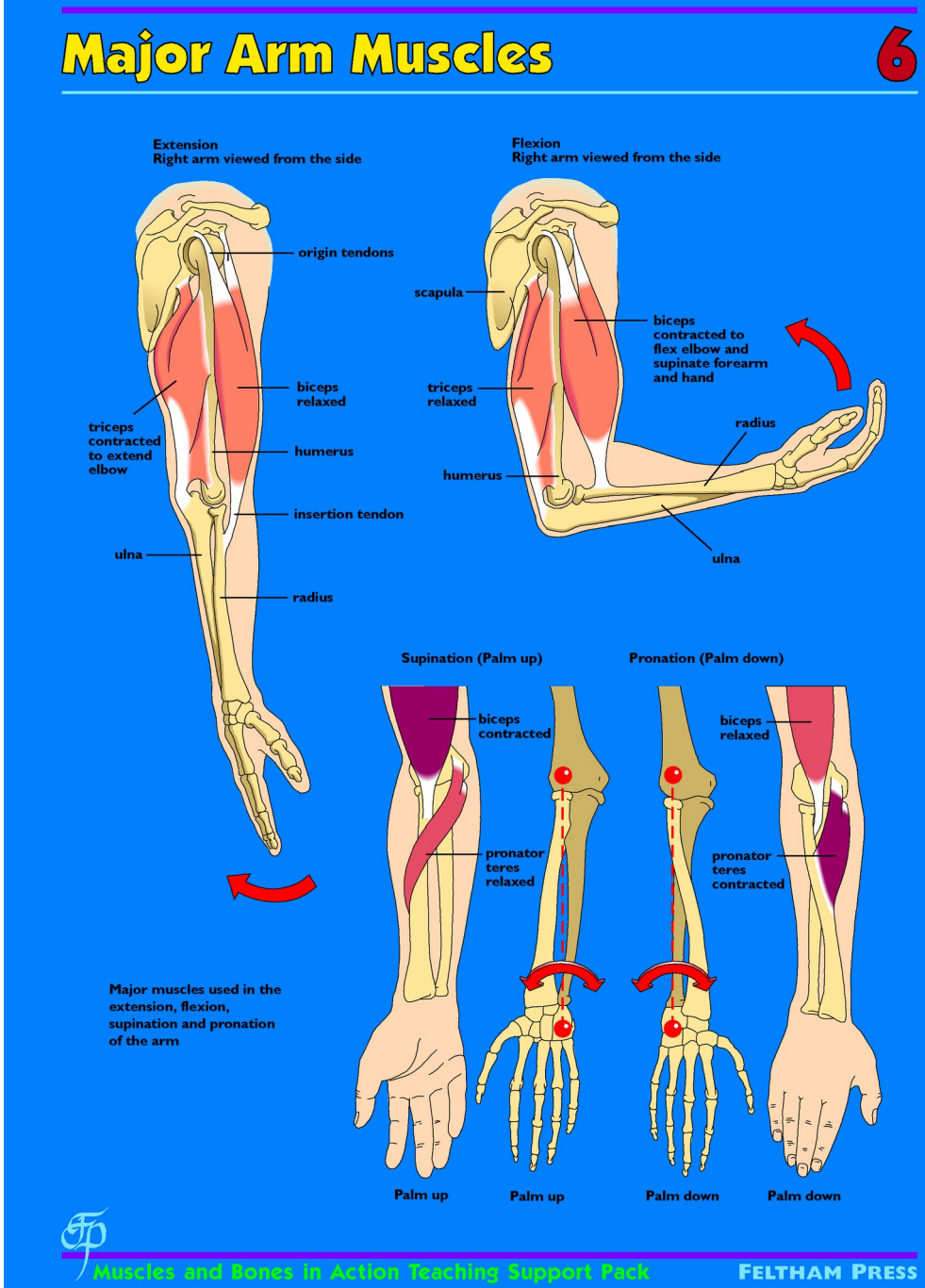
It is in the upper arm that the arrangement of muscles into opposing or ‘antagonistic’ pairs or groups is most clearly seen.

Such an arrangement is necessary as muscles can only contract actively, and must be restretched by the action of an opposing muscle or group.

This can be aided by

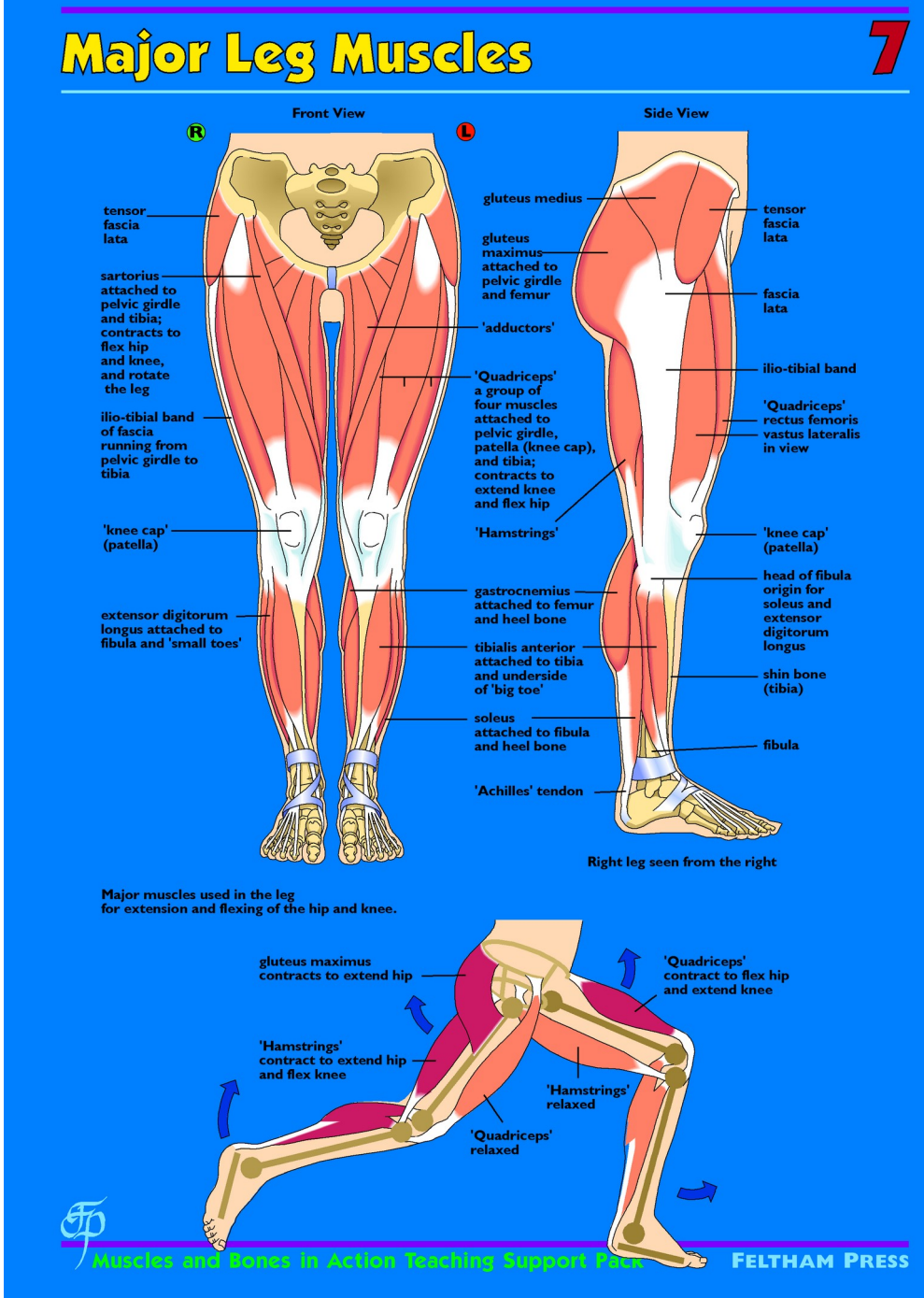


These are involved in both movement and support.

The ‘buttocks’ and the ‘calf’ muscles are important in maintaining upright posture.

They, along with the back muscles, oppose the tendency of the human body to ‘fall’ forwards.

Cycling tends to concentrate effort in


Major Leg Muscles
7
Front View
R
L
tensor fascia lata
sartorius attached to pelvic girdle and tibia; contracts to flex hip and knee, and rotate the leg
ilio-tibial band of fascia running from pelvic girdle to tibia
'knee cap' (patella)
extensor digitorum longus attached to fibula and 'small toes'
'adductors'
'Quadriceps' a group of four muscles attached to pelvic girdle, patella (knee cap), and tibia; contracts to extend knee and flex hip
'Hamstrings'
gastrocnemius attached to femur and heel bone
tibialis anterior attached to tibia and underside of 'big toe'
soleus attached to fibula and heel bone
'Achilles' tendon
Major muscles used in the leg for extension and flexing of the hip and knee.
Side View
gluteus medius
gluteus maximus attached to pelvic girdle and femur
tensor fascia lata
fascia lata
ilio-tibial band
'Quadriceps' rectus femoris
vastus lateralis in view
'knee cap' (patella)
head of fibula origin for soleus and extensor digitorum longus
shin bone (tibia)
fibula
Right leg seen from the right
gluteus maximus contracts to extend hip
'Quadriceps' contract to flex hip and extend knee
'Hamstrings' contract to extend hip and flex knee
'Hamstrings' relaxed
'Quadriceps' relaxed
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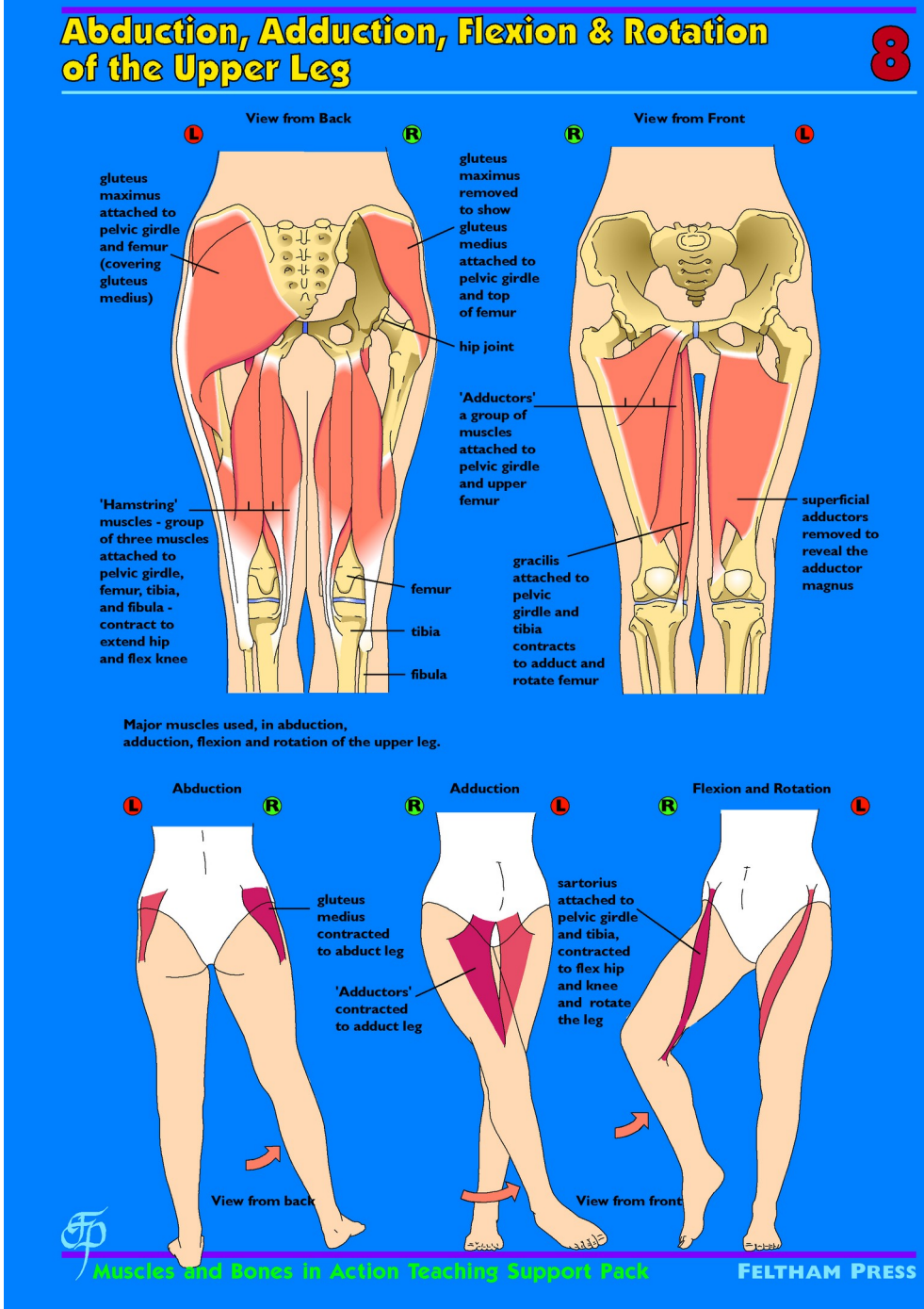
When a leg is brought up in front of the body the hip joint is said to be flexed.

When the leg is returned to the ground, and moved as far back as possible the hip joint is said to be extended.

Abduction moves the leg away from the body.

Adduction brings the leg towards the


Abduction, Adduction, Flexion & Rotation of the Upper Leg
8
View from Back
View from Front
gluteus maximus attached to pelvic girdle and femur (covering gluteus medius)
gluteus maximus removed to show gluteus medius attached to pelvic girdle and top of femur
hip joint
'Adductors' a group of muscles attached to pelvic girdle and upper femur
'Hamstring' muscles - group of three muscles attached to pelvic girdle, femur, tibia, and fibula - contract to extend hip and flex knee
femur
tibia
fibula
gracilis attached to pelvic girdle and tibia contracts to adduct and rotate femur
superficial adductors removed to reveal the adductor magnus
Major muscles used, in abduction, adduction, flexion and rotation of the upper leg.
Abduction
Adduction
Flexion and Rotation
gluteus medius contracted to abduct leg
'Adductors' contracted to adduct leg
sartorius attached to pelvic girdle and tibia, contracted to flex hip and knee and rotate the leg
View from back
View from front
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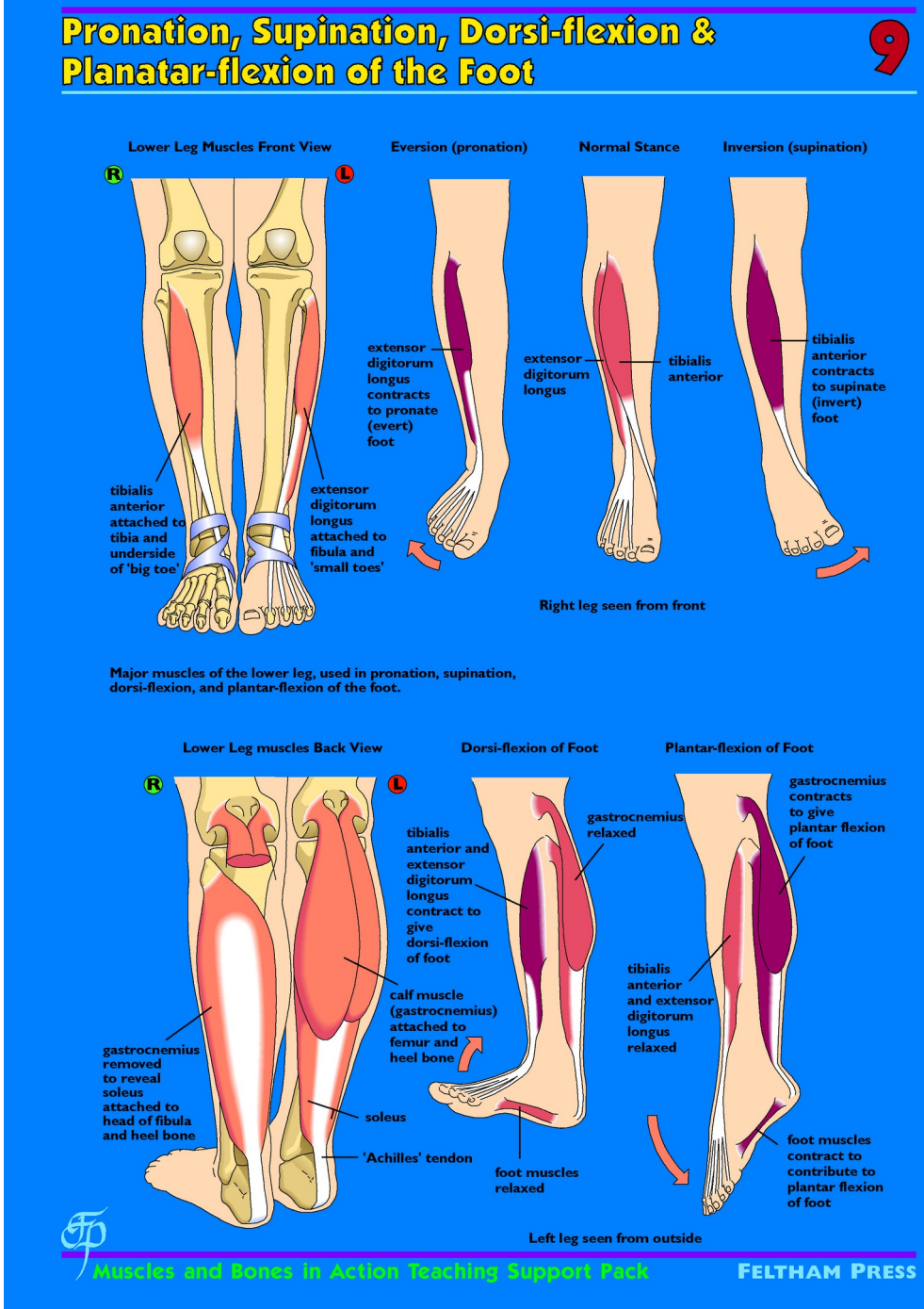
The balance of the body on the feet, is dependent upon the complex movements of the ankle joint.

Pronation of the foot, is the equivalent position to the hand being palm down.

Supination is the equivalent position to the hand being palm up.


Pronation, Supination, Dorsi-flexion & Planatar-flexion of the Foot
9
Lower Leg Muscles Front View
Eversion (pronation)
Normal Stance
Inversion (supination)
R
L
tibialis anterior attached to tibia and underside of 'big toe'
extensor digitorum longus attached to fibula and 'small toes'
extensor digitorum longus contracts to pronate (evert) foot
extensor digitorum longus
tibialis anterior
tibialis anterior contracts to supinate (invert) foot
Right leg seen from front
Major muscles of the lower leg, used in pronation, supination, dorsi-flexion, and plantar-flexion of the foot.
Lower Leg muscles Back View
Dorsi-flexion of Foot
Plantar-flexion of Foot
gastrocnemius removed to reveal soleus attached to head of fibula and heel bone
soleus
'Achilles' tendon
tibialis anterior and extensor digitorum longus contract to give dorsi-flexion of foot
calf muscle (gastrocnemius) attached to femur and heel bone
gastrocnemius relaxed
foot muscles relaxed
gastrocnemius contracts to give plantar flexion of foot
tibialis anterior and extensor digitorum longus relaxed
foot muscles contract to contribute to plantar flexion of foot
Left leg seen from outside
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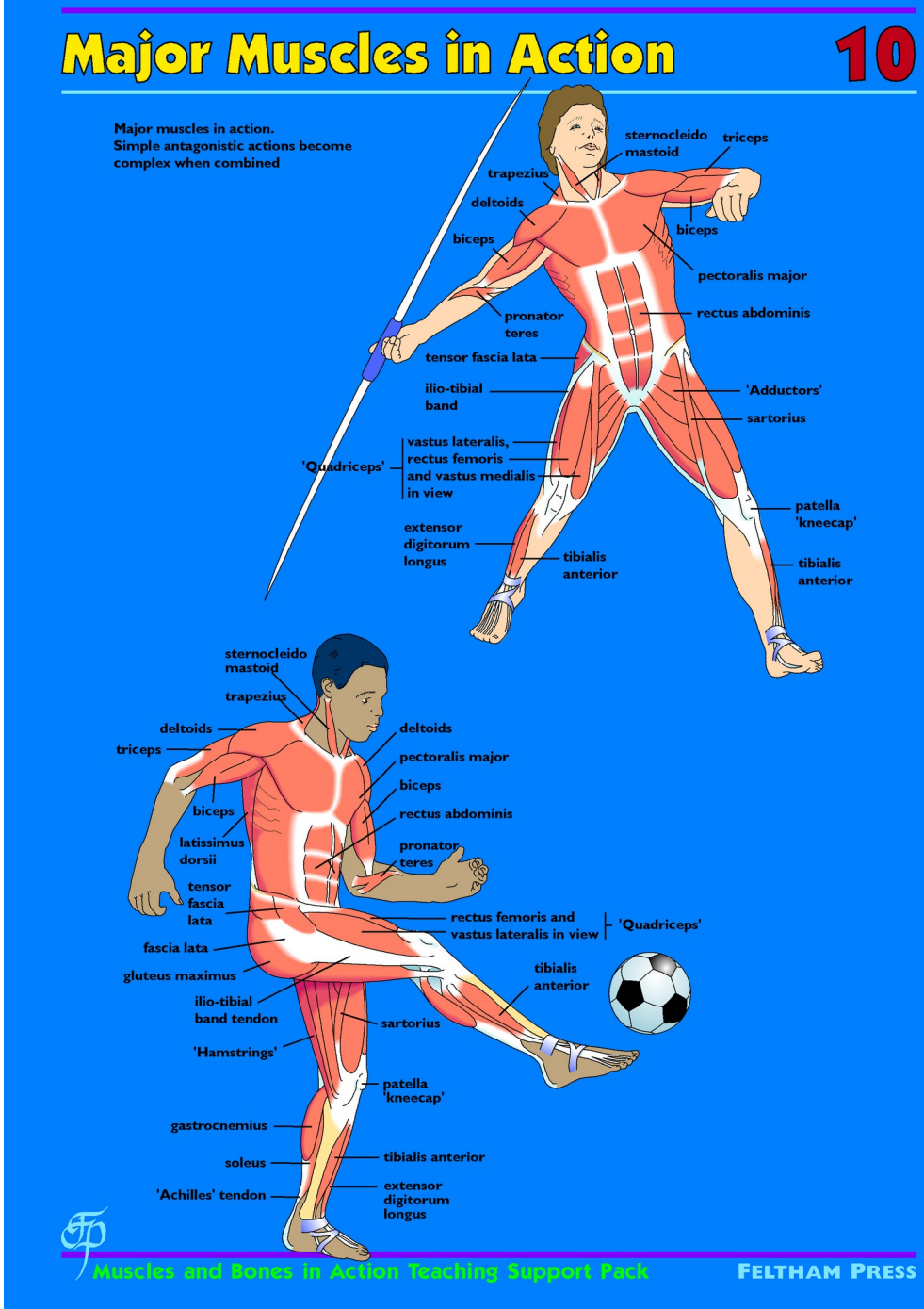
Virtually every muscle in the body is involved in complex sports actions, but major groups can be identified in particular sport actions.

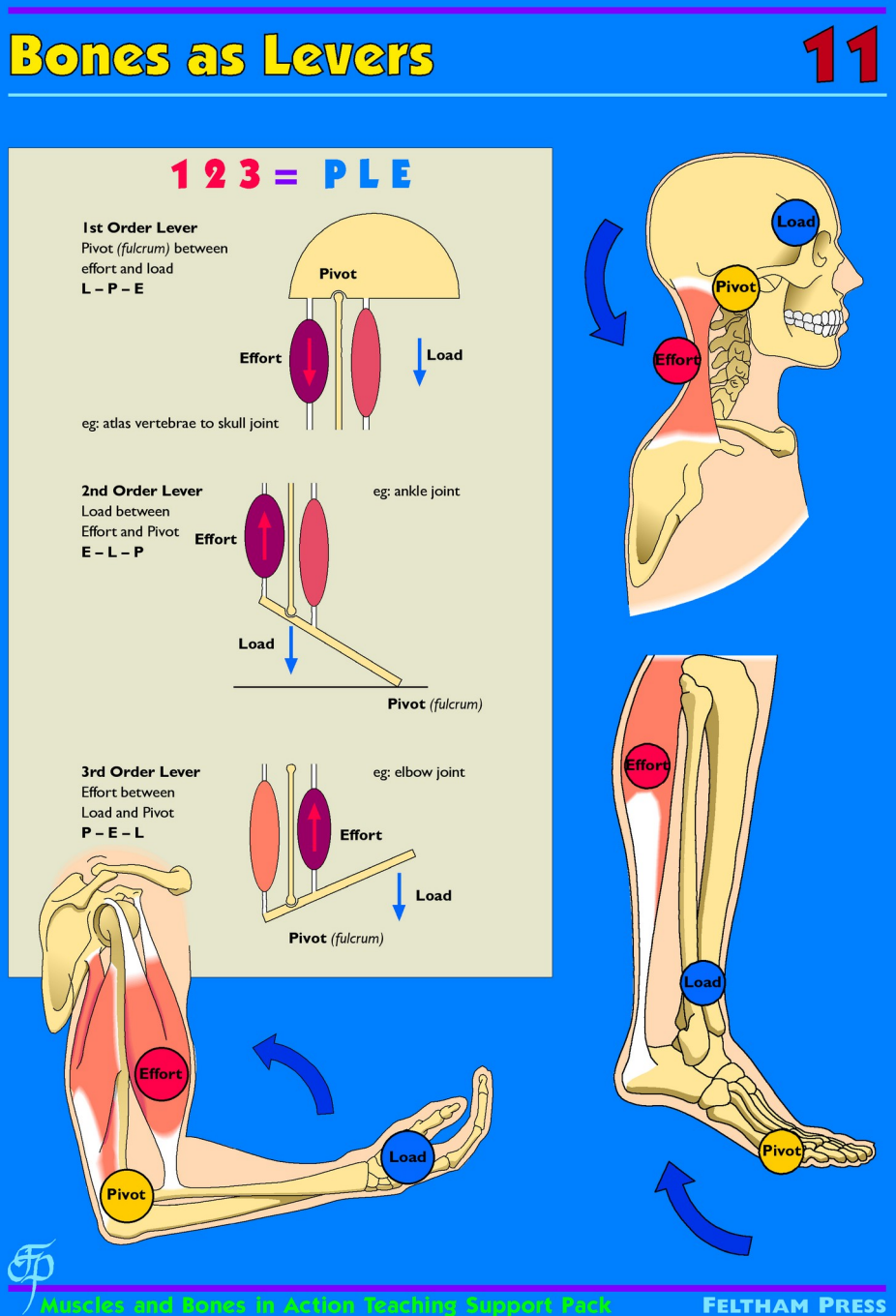
Technically incorrect actions can result in injury, such as too much use of the elbow in tennis elbow.

However even



In the human skeleton they virtually all work at a mechanical disadvantage, that is more effort is exerted than effect produced.

The biceps would produce greater strength if they were attached (inserted) nearer to the hand, but they would produce a smaller range of movement.



The upright posture of humans is unique.

It places great demands on the skeleton and muscles, and some claim that it is imperfectly developed, leading to many common complaints – especially ‘bad backs’, as we continually fight the tendency to ‘fall’ forwards.

Although difficult to maintain, good